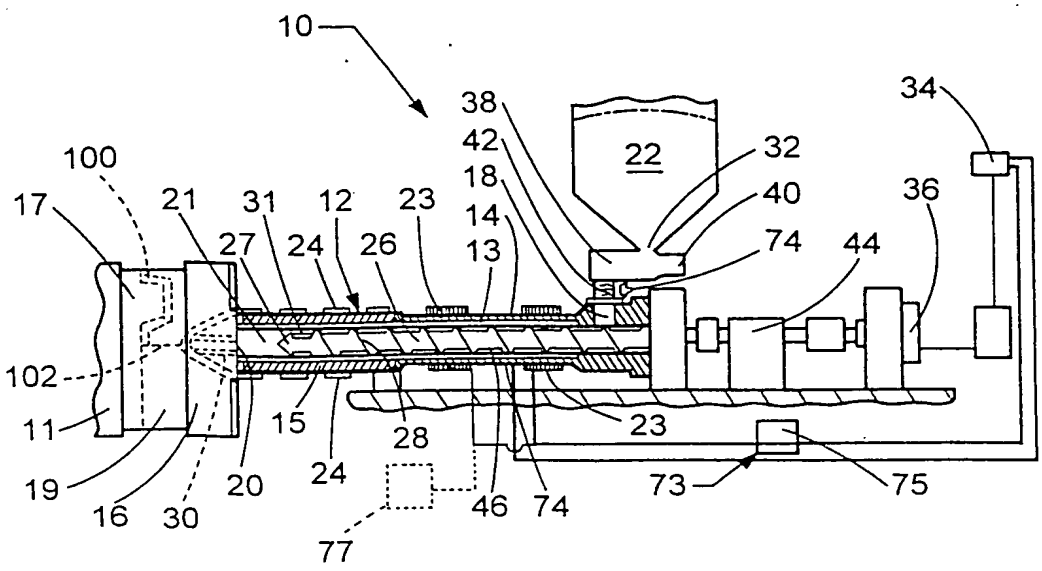
10
38
42
18
14
13
22
32
40
74
34
36
44
100
17
21
31
12
23
27
24
26
102
11
19
16
30
20
15
24
28
46
74
23
73
75
77

Fig. 1

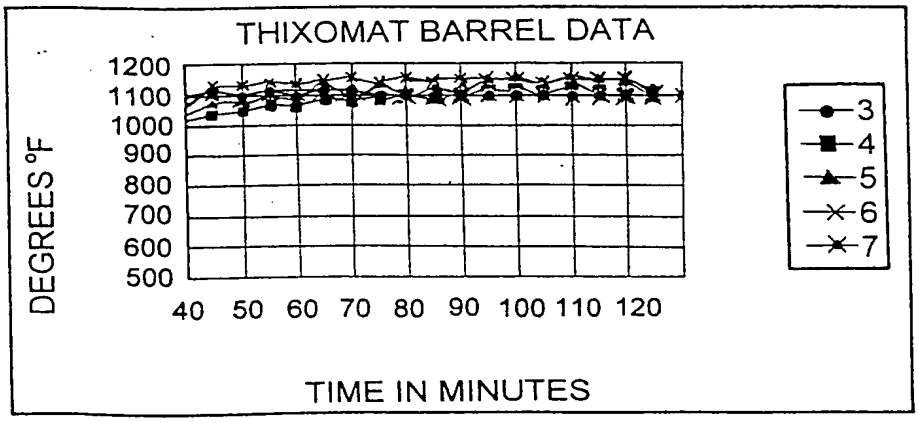
THIXOMAT BARREL DATA
DEGREES °F
1200
1100
1000
900
800
700
600
500
40 50 60 70 80 90 100 110 120
TIME IN MINUTES
3
4
5
6
7

Fig. 2B

°F

TIME MINUTES	ZONE 1			ZONE 2			
	1	2	3	4	5	6	7
	634	968	1100	1004	1020	1093	1100
45	641	973	1101	1032	1041	1113	1100
50	658	976	1100	1054	1043	1122	1100
55	670	980	1101	1071	1091	1123	1099
60	678	982	1100	1078	1088	1122	1100
65	693	981	1101	1098	1107	1132	1101
70	705	1001	1101	1093	1084	1133	1099
75	709	989	1100	1097	1126	1125	1103
80	712	993	1100	1100	1101	1133	1103
85	721	996	1100	1094	1110	1128	1102
90	728	994	1100	1099	1104	1130	1099
95	735	994	1100	1105	1114	1137	1101
100	747	1000	1100	1106	1117	1137	1099
105	750	1006	1100	1105	1112	1133	1103
110	746	1005	1100	1109	1114	1136	1101
115	750	1003	1100	1105	1116	1135	1100
120	763	1001	1100	1101	1121	1136	1099
TARGET			1100	1100	1100	1100	1100

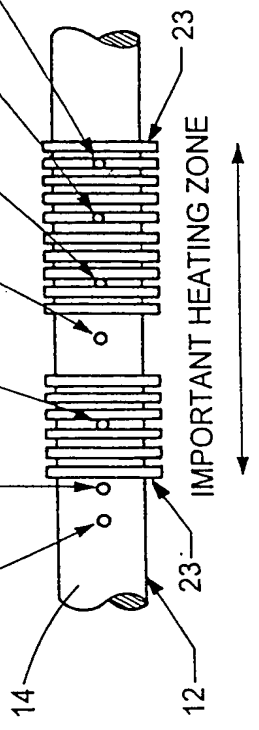

Fig. 2A

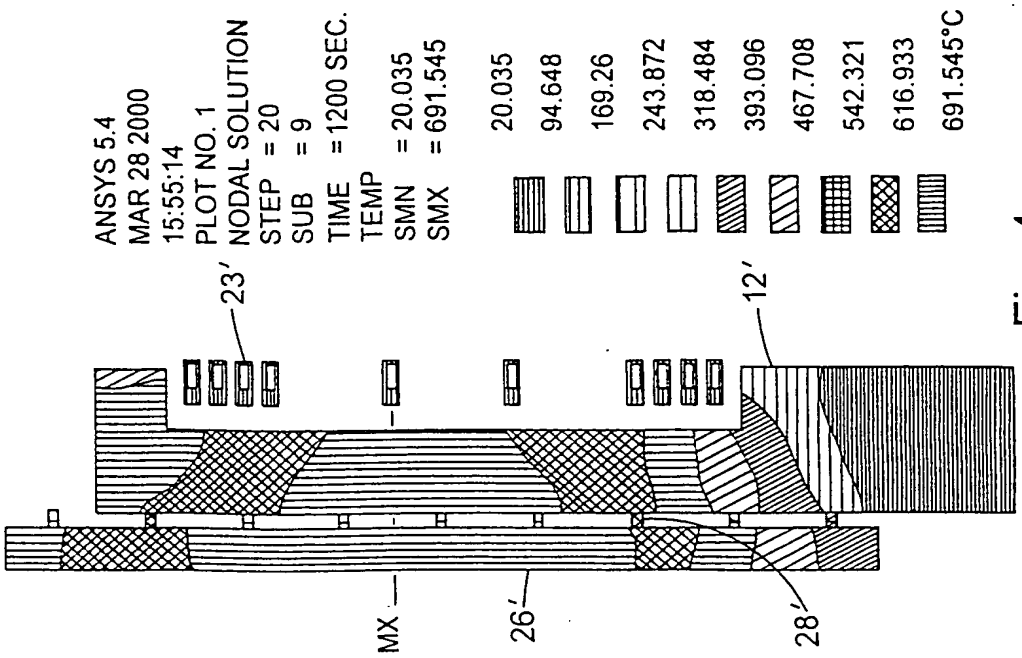
ANSYS 5.4
MAR 28 2000
15:55:14
PLOT NO. 1
NODAL SOLUTION
STEP = 20
SUB = 9
TIME = 1200 SEC.
TEMP
SMN = 20.035
SMX = 691.545
20.035
94.648
169.26
243.872
318.484
393.096
467.708
542.321
616.933
691.545°C
23′
12′
MX
26′
28′

Fig. 4

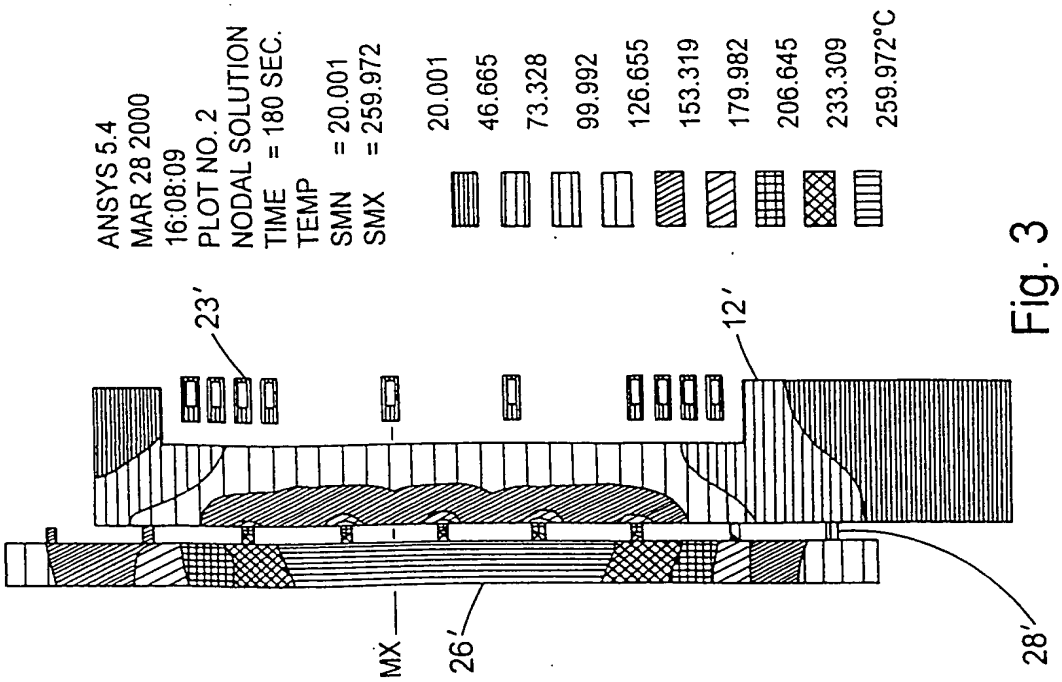
ANSYS 5.4
MAR 28 2000
16:08:09
PLOT NO. 2
NODAL SOLUTION
TIME = 180 SEC.
TEMP
SMN = 20.001
SMX = 259.972
20.001
46.665
73.328
99.992
126.655
153.319
179.982
206.645
233.309
259.972°C
23′
12′
MX
26′
28′

Fig. 3

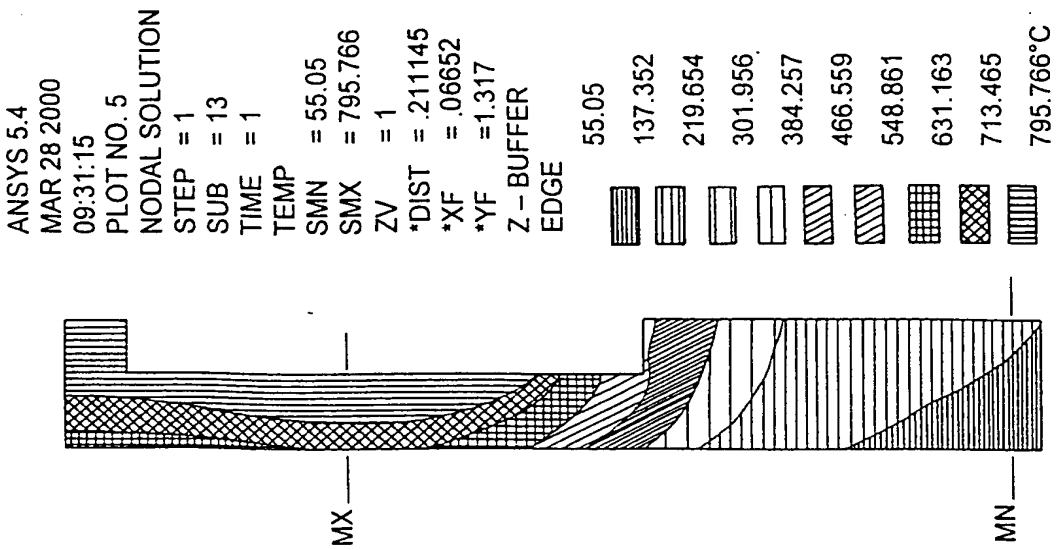
ANSYS 5.4
MAR 28 2000
09:31:15
PLOT NO. 5
NODAL SOLUTION
STEP = 1
SUB = 13
TIME = 1
TEMP
SMN = 55.05
SMX = 795.766
ZV = 1
*DIST = .211145
*XF = .06652
*YF = 1.317
Z-BUFFER
EDGE
55.05
137.352
219.654
301.956
384.257
466.559
548.861
631.163
713.465
795.766°C
MX
MN

Fig. 6

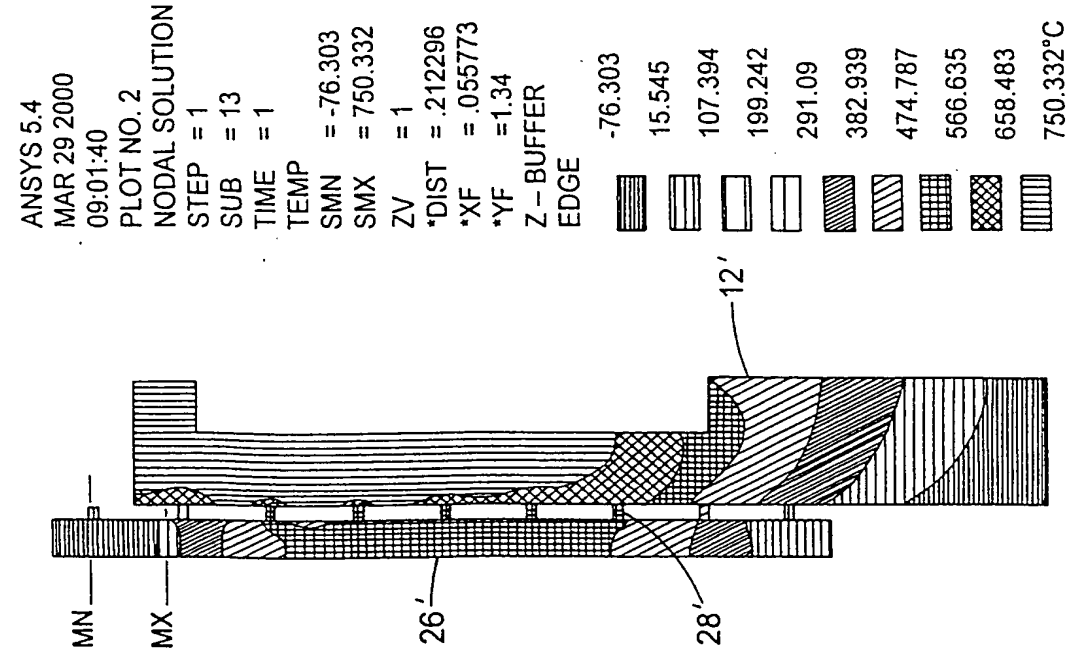
ANSYS 5.4
MAR 29 2000
09:01:40
PLOT NO. 2
NODAL SOLUTION
STEP = 1
SUB = 13
TIME = 1
TEMP
SMN = -76.303
SMX = 750.332
ZV = 1
*DIST = .212296
*XF = .055773
*YF = 1.34
Z-BUFFER
EDGE
-76.303
15.545
107.394
199.242
291.09
382.939
474.787
566.635
658.483
750.332°C
MN
MX
26'
28'
12'

Fig. 5

BENEFIT OF LOW FREQUENCY INDUCTION HEATING ON BARREL SHELL AND LINER STRESS DURING PREHEATING (20 MINUTES) (FOR 0.5 IN. SHRUNK FIT STELLITE LINER IN A 1.85 IN. ALLOY 718 SHELL)

			STRESS, KSI			
HEATING METHOD	ΔT °F	COMPONENT	LONG	RADIAL	HOOP	VON MISES
CERAMIC BAND	403[1]	LINER	107	43	102	111[2]
		SHELL	38	43	26	
LOW FREQUENCY INDUCTION	0[3]	LINER	-16	-2	-13	15[4]
		SHELL	4	-2	7	

1. BARREL STILL ONLY AT 700°F, 850 TON BARREL REQUIRES THREE HOURS TO PREHEAT WITHOUT HIGH STRESSES.
2. LINER YIELDS ON HEATING AT 600°F.
3. BARREL AT 1200°F, READY TO RUN.
4. LINER DOES NOT YIELD.

Fig. 7

Patent Application for: Apparatus for Molding Metals
Inventor(s): Akers, et al
Attorney Docket No.: 10958-231

BENEFIT OF LOW FREQUENCY INDUCTION HEATING AZ91D ON A SIZE

	DIMENSION OF g PARTICLES (AVERAGE OF 240 PARTICLES)				
HEATING METHOD	AREA, μ^2	PERIMETER, μ^2	ROUNDNESS, μ^2	WIDTH, μ^2	HEIGHT, μ^2
CERAMIC BAND	1202	331	60.8	40	42
LOW FREQUENCY INDUCTION	758	241	63	35	34

Fig. 8

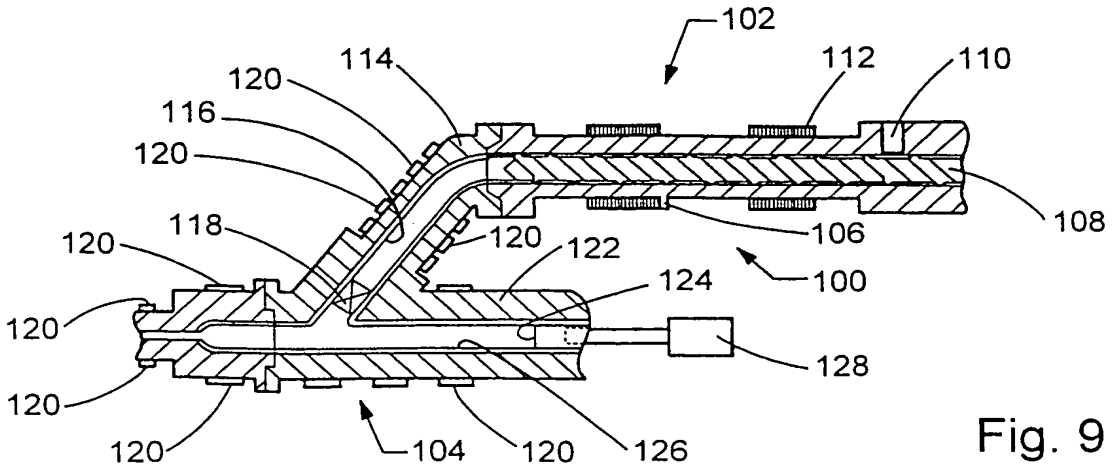
102
114
112
110
120
116
120
118
120
120
122
124
106
108
100
120
120
128
120
104
120
126

Fig. 9

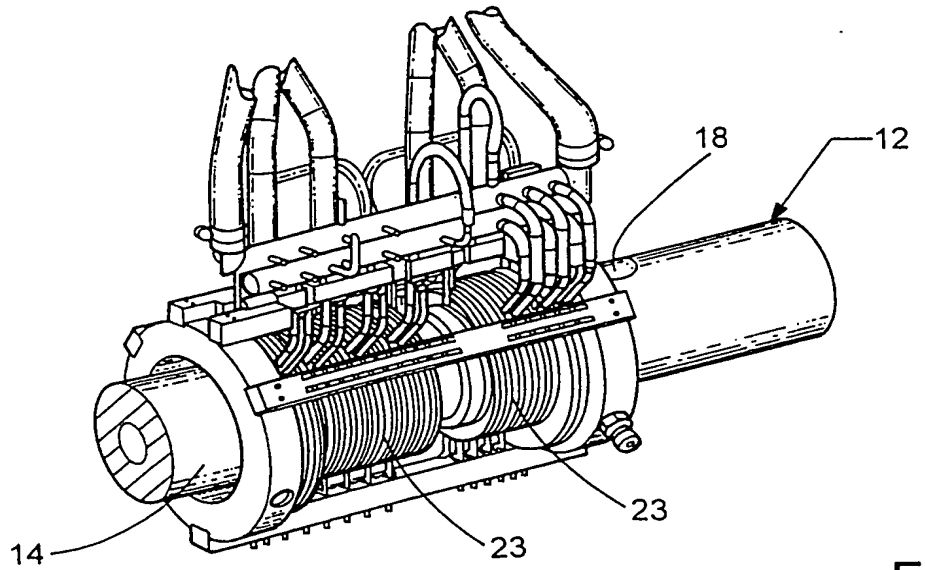
18
12
23
14
23

Fig.10